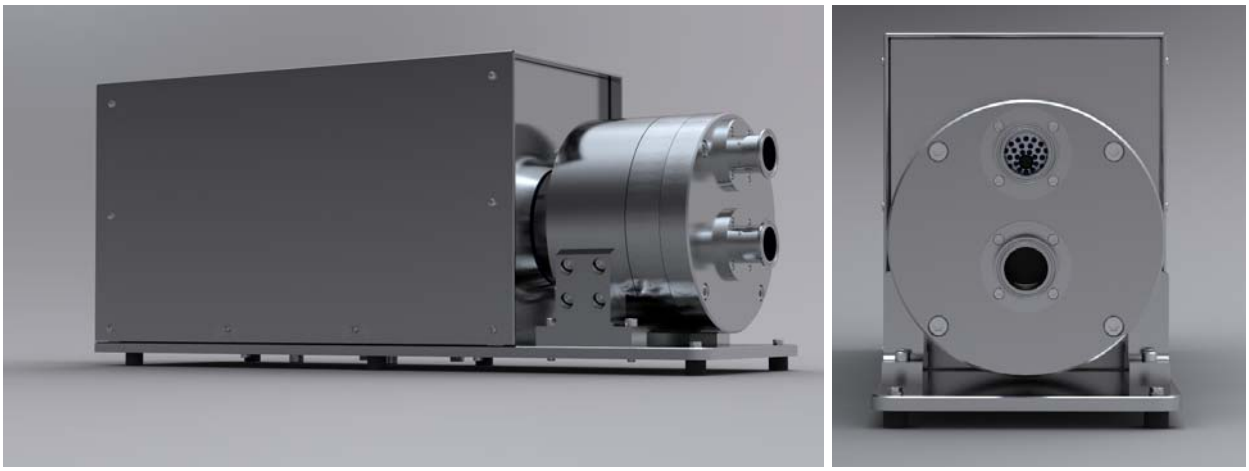
Version of April 2009

User Manual

Quattroflow-QF4400 Series

4-Piston Diaphragm Pump



Pictures of a Quattroflow QF4400 Pump

Safety

These operating instructions contain precautions to be observed during installation, operation and maintenance. Therefore, prior to mounting and commissioning, these operating instructions must be read by the user and must always be available at the place of installation.

Performance Data

The exact performance data applying to the pump are to be taken from the order data sheet.

These Operating and Maintenance instructions contain information from the pump manufacturer. They may need to be supplemented by instructions of the operator company for its personnel.

ALMATEC Maschinenbau GmbH is constantly working on improvements of the pump. Modifications of the design or materials might be done without prior notice.

1. General
- 1.1 Appropriate Specification
- 1.2 Labelling of the Pump

2. Safety
- 2.1 Marking of precautions in the operating instructions
- 2.2 Personnel qualification and personnel training
- 2.3 Responsible working
- 2.4 Dangers in case of non-compliance with the safety precautions
- 2.5 Safety precautions fort the user and/or operator
- 2.6 Safety precautions for maintenance, inspection and mounting operations
- 2.7 Arbitrary reconstruction and spare part production
- 2.9 ***Attention! Warning precautions!***
- 2.10 ***Attention! Safety precautions!***

3. Description of the Quattroflow QF4400 Pump
- 3.1 Application and range of utilization of the Quattroflow QF4400 pump
- 3.2 Typical application of the Quattroflow QF4400 pump
- 3.3 Description of the function of the Quattroflow QF4400 pump
- 3.4 Start-up

4. Maintenance and servicing of the Quattroflow QF4400 pump
- 4.1 Dismount the pump chamber
- 4.2 Mount the pump chamber
- 4.3 Changing seals and diaphragms
- 4.4 Changing of the shaft bearing unit

5. Operating troubles, causes and remedial actions
- 5.1 Pump does not start
- 5.2 Pump does not prime
- 5.3 Delivery is not obtained
- 5.4 Pressure head is not obtained
- 5.5 Irregular pump delivery
- 5.6 Pump operates noisily
- 5.7 Pump is leaky
- 5.8 Motor gets to warm

6. Performance chart of the Quattroflow QF4400 pump
- 6.1 Diagram 1 Discharge as function of pump rpm

7. Technical data of the Quattroflow QF4400 pump

1. General:

1.1 Appropriate specification

This User Manual is valid for the **Quattroflow QF4400 pump**

No liability will be undertaken for any damages caused by non-compliance with the operating instructions and service conditions! Original spare parts serve safety purposes. The use of other parts may cancel the liability for the consequences resulting there from.

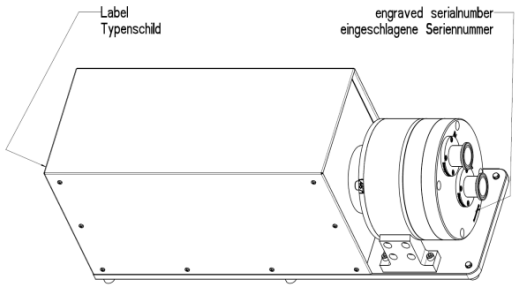
Manufacturer: ALMATEC Maschinenbau GmbH

Carl-Friedrich-Gauss-Str. 5
D-47475 Kamp-Lintfort
Germany

Phone: +49 2842 961-0
Fax: +49 2842 961-40
e-mail: quattroflow@almatec.de
Internet: www.quattroflow.com

1.2 Labelling of the pump

The type label of each Quattroflow pump can be seen on the bottom of the base plate.
Besides the serial No of the pump head is punshed in, at the front cover.



2. Safety

The operating instructions are recommended to be followed during installation, operation and maintenance. Prior to mounting and commissioning, the operating instructions must be followed by authorized personnel. The manual should be kept with the pump for future reference. The general safety warnings in Section 2 "Safety" are to be observed, in addition to the safety procedures for the user's site.

2.1 Warning Symbols

If the safety warnings contained in the operating instructions are not followed, this may result in danger to personnel or surroundings. The following symbols indicate the necessary precaution for the particular hazard.

Danger Warning:

Safety sign according to DIN 4844 - W 9

Electrical Shock Warning:

Safety sign according to DIN 4844 – W8

Safety procedures that are not followed may cause danger to the pump itself or to parts of the system are marked with the word or indication: ***ATTENTION!***

- ***Pmax 8bar***
- ***Direction of flow***
- ***Removing or damaging warning labels and signs is prohibited***

2.2 Precautions for maintenance, inspection, mounting and operation

The customer shall see to it that all maintenance, inspection and mounting operations are performed by authorized and qualified personnel. Pump maintenance should be performed only when the pump is stopped and power is disconnected. Pumps handling hazardous materials must be decontaminated.

2.3 Operator's Responsibility

Please follow the safety procedures provided by operator's site or facility. For example, material handling, hazardous materials, biological materials, handling of tubing, piping, instrumentation, and fittings.

2.4 Non-compliance of safety warnings

Failure to follow safety precautions may cause danger to personnel, equipment and environment. Such as:

- Failure of the proper function of the pump/system.
- Danger to personnel by electrical, mechanical, chemical, biological impacts.
- Danger to equipment and environment

2.5 Safety precautions for the operation

Protective measures should be observed while processing hot fluids (i.e. CIP or SIP).

Removing protecting covers of moving parts is prohibited.

Hazardous material spills must be handled in accordance to local codes and procedures

2.6 Safety precautions for maintenance, inspection and mounting operations

The customer should verify that all maintenance, inspection and mounting operations are performed by authorized and qualified personnel.

Maintenance and service of the pump must be performed while the pump is stopped.

Pumps or aggregates handling hazardous fluids must be decontaminated.

2.7 Arbitrary reconstruction and spare part construction

Reconstruction of or changes to the machine are only admissible after consultation with the manufacturer. Original spare parts and accessories authorized by the manufacturer serve safety purposes. The use of other parts may cancel the liability for the consequences resulting here from.

2.8 Inadmissible modes of operation

The operating safety of the machine supplied is only ensured with due application according to the operating instructions. Do not exceed the limit values given in the data sheet.

2.9 Attention*! Warning precautions!*

These warning precautions are to prevent the user from an inadmissible mode of operation. These warning precautions are to be strictly followed to avoid any damage of the pump and/or any danger to personnel.

Diaphragm pumps are positive displacement pumps and can theoretically generate an infinitely high pressure. With the discharge line closed, for example by clogging or by incidental closing of a valve, the pressure generated by the pump may reach a multiple of the admissible pressure of the plant. This may lead to bursting of the diaphragm or lines which must be absolutely avoided especially when handling dangerous products.

- ⚠ Diameter of the suction line need to be sufficient to avoid cavitation.
- ⚠ The use of a safety device (i.e. pressure switch) can be necessary.
- ⚠ Please make sure that prior to the start of the pump the discharge line is checked. Make sure that there is no flow restriction in the discharge line to avoid any over pressure (i.e. closed valve).
- ⚠ Check all seals (i.e. TC clamps) before starting the pump.

The maximum discharge pressure depends on the temperature of the fluid.

P_{max} at room temperature = 8 bar
P_{max} at 90° C = 3 bar

Please allow the pump to cool down after heat treatment (i.e. CIP / SIP).

Flush the pump prior to use with appropriate fluid (i.e. buffer)

- ⚠ Foundation design: The foundation must be designed so that it can take the weight of the pump aggregate on the entire surface.
- ⚠ Please make sure that the pump is operated with the proper mains voltage and frequency to avoid damages and electrical danger.
- ⚠ Make sure that the slots for the cooling air are not blocked.

Due to the versatile possibilities to use the Quattroflow QF4400 pump it is highly recommended to check case by case if the Quattroflow QF4400 pump will be the right tool for the specific application. The user/operator is responsible to perform a proper method of testing if the pump should be applied for his specific application.

The chemical and thermal compatibility of the elastomeric parts of the pump with the fluid that will be pumped are to be checked by the operator before the first process run.

For example, oily, fatty fluids or solvents might cause a swelling and/or destruction of the elastomers.

If in doubt, please contact the manufacturer!

- ⚠ Operating the pump in humid or aggressive air cancause damages to the motor and control box..
- ⚠ the control box should not be exposed to spray/splash water or to heat sources

If the Quattroflow QF4400 pump is to be used under rough conditions (i.e. high-pressure cleaners, exposed to sea water), the manufacturer can supply special equipment, like motors and controls.

2.10 Attention! Safety Precautions!

The following safety precautions notify you of the potential of bodily harm or life danger of the user/operators!

- ⚠ Please read and follow the safety precautions and warnings to avoid any risk of bodily harm, life danger and/or the damage of equipment.
- ⚠ Please keep this User Manual available. Make sure that the operators of the pump have read and understood the User Manual. A training session might be appropriate.
- ⚠ We recommend installing specific warning labels at the system.

Disconnect mains before doing any maintenance!
The housing of the control box is to be opened only by skilled personnel.
Check the electrical cables before connecting to mains supply.

- ⚠ The Quattroflow QF4400 is a positive displacement pump and can theoretically generate an infinitely high pressure even at low speed (rpm). Prior to each start of the pump check and make sure that the discharge line is not closed or restricted. The design of the discharge line must not build up a pressure of >8 bar.
- ⚠ If suction and/or discharge line are flexible tubing, then make sure that these tubing does have the proper pressure rating for the full range of temperatures that are applied.

Pmax = 8 bar, Do not exceed! Warning Label: p max: 8 bar! Do not remove!
If the maximum pressure is exceeded it can happen that the diaphragm of the pump will burst. In this case the fluid will come out of the pump and can cause a danger for the personnel and/or environment (i.e. caustic cleaner).

The Quattroflow QF4400 pump can pump air which means that most of the fluid inside the pump chamber will be pump out. However there will be a residual amount of fluid (approximately 100-500 ml) inside the pump chamber that should be flushed out of the pump before the pump will be opened.

- ⚠ Please follow the general safety guidelines when handling chemical fluids (wear gloves and/or glasses) before the pump chamber will be opened.
- ⚠ Never operate the pump without coupling and motor housing.
- ⚠ The foundation must be designed so that it can take the weight of the pump on the entire surface.

The Quattroflow QF4400 must not be operated in ATEX zones.
Please contact the manufacturer in case the Quattroflow QF4400 pump needs to be modified for ATEX applications.

ALMATEC Maschinenbau GmbH

Attention! Inadmissible modes of operation, arbitrary reconstruction, spare parts production and/or any changes of the design (without admission of the manufacturer) may cancel the liability for the consequences resulting there from.

3. Description of the Quattroflow QF4400 pump

3.1 Application and range of utilization of the Quattroflow QF4400 pump

The Quattroflow QF4400 is a 4-piston Diaphragm pump, which is mainly used to pump water-like fluids that are typically handled in research, pilot plant or production facilities of the pharmaceutical, biotech, food or cosmetic research centres or plants.

Typical examples of these fluids:

- Solutions containing proteins (albumin, IgG, Clotting factors, monoclonal antibodies, enzymes, vaccines.)
- Solutions of polymers or suspensions (silicones, latex, chromatography media)
- Cell suspensions (bacteria, yeast, algae, fungi, mammalian cells)
- colloidal solutions
- Suspensions of viruses or phages
- Dairy products
- Gelatin
- Supplements and ingredients for cosmetic and food.

3.2 Typical process steps in which the Quattroflow QF4400 pump is used

Filtration technology

- To recirculate feed/retentate (i.e. membrane cassettes, hollow fibre, spiral wound, ceramic elements.
- Feed pump for filter cartridges or plate and frame depth filters

Chromatography:

- Packing of chromatography columns
- Feed pump to mix gradients
- Feed pump for centrifuges or separators
- Feed pump for homogenizers
- Feed pump for filling machines

3.3 Discription of the working princaple Quattroflow QF4400

The Quattroflow QF4400 pump is a 4-piston diaphragm pump. The 4 segments of the pump diaphragm oscillate back and forth. This alternate movement is created by a nutation disc that is arranged on a ball bearing. The ball bearing sits on an eccentric shaft. The nutation disc does not turn!
The stroke of the pistons is determined by the angle of the 6° eccenter shaft.
Range of flow rate: appr. 100 -5.000 L/hr
The drive = motor + control needs to be choosen according to application.

Please note:

The direction of flow can be adjusted by turning the pump chamber in 90° steps.

The Quattroflow QF4400 is **self-priming and can run dry**. Inside the pump chamber there are no rotating parts that might cause heating up of the product or shed particles.

The pump-motor unit is mounted on a stainless steel base plate. In case that the pump will not be mounted on the base plate but in a frame or any other base measures have to be taken that there will be a proper alignment of the motor and the pump.

3.4 Start-Up

Prior to leaving our factory all pumps are subjected to a leakage and performance test. Only properly operating pumps leave the factory achieving the performances assured by us. It is possible that there will be a few milliliters of water inside the pump.

Prior to each use we recommend flushing the pump with a proper fluid (i.e. water or buffer)

Prior to the very first use it might make sense to clean and sanitize the pump chamber. A commercial caustic cleaner and/or 0.5 to 1 mol of NaOH can be used. The chosen cleaning agent can be recirculated and also stored inside the pump chamber.

For flushing out of any cleaning agent do not recirculate! Check with appropriate analytical methods the success of the flushing procedure.

Recommendation: Test run prior first use!

Before using your pump in your process (for example as recirculation pump in a TFF system) perform a test run to get used to the specific properties of the pump.

Please note:

ALMATEC Maschinenbau GmbH is also building custom-made pumps and set-ups. These modified pumps can be different from this one that is described in here. However the basic information is applicable to all of the Quattroflow QF4400 Series pumps.

Please do not hesitate to contact us for further information:

ALMATEC Maschinenbau GmbH

Carl-Friedrich-Gauss-Str. 5
D-47475 Kamp-Lintfort
Germany

Phone: +49 2842 961-0
Fax: +49 2842 961-40
e-mail: quattroflow@almatec.de
Internet: www.quattroflow.com

4. Maintenance/Servicing of the Quattroflow QF4400 pump

Due to the robust construction the Quattroflow QF4400 pump requires only little and easy- to-do maintenance. The ball bearings do not need any extra lubrication.

The diaphragm and the valves are wear parts. These should be checked and if needed be changed once the performance of the pump decreases.
If the diaphragm breaks, it needs to be replaced. It is recommended to check the ball bearings, replace the ball bearings if the ball bearings are hard to turn or are noisy during operation.

Attention! Safety precautions!

After purging the pump with air there might be a small residual amount of fluid inside the pump chamber.
Flush the pump chamber thoroughly and check the rinse fluid.

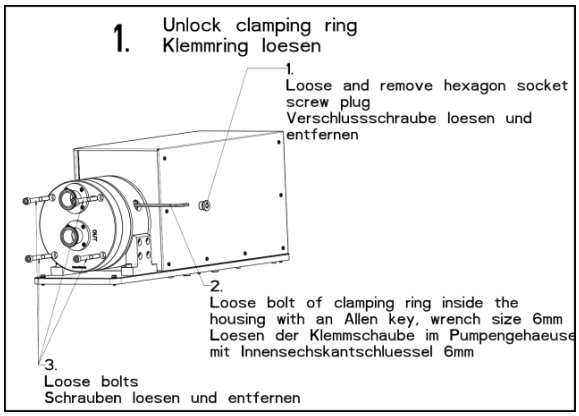
Please follow the general guidelines and safety precautions when handling with chemicals.

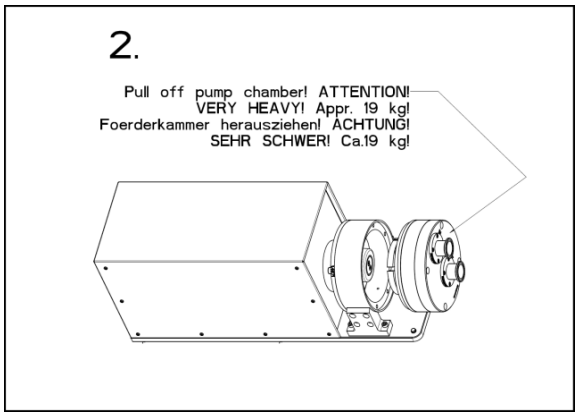
Disconnect mains supply before opening the pump housing!

The dismounting and mounting of the pump should be done on a rigid table or work bench. Please note: the pump is heavy.

4.1 Dismount the pump chamber

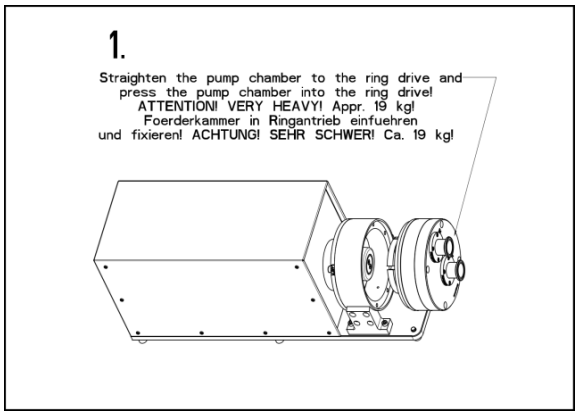
The dismounting of the pump chamber can be done by the user.

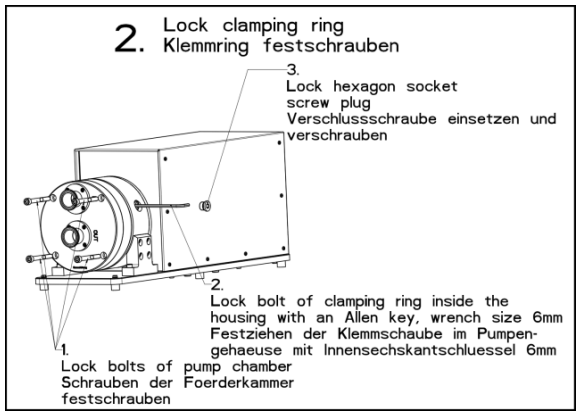

1.
Unlock clamping ring
Klemmring loesen
1.
Loose and remove hexagon socket screw plug
Verschlussschraube loesen und entfernen
2.
Loose bolt of clamping ring inside the housing with an Allen key, wrench size 6mm
Loesen der Klemmschaube im Pumpengehaeuse mit Innensechskantschluessel 6mm
3.
Loose bolts
Schrauben loesen und entfernen



4.2 Mount the pump chamber:

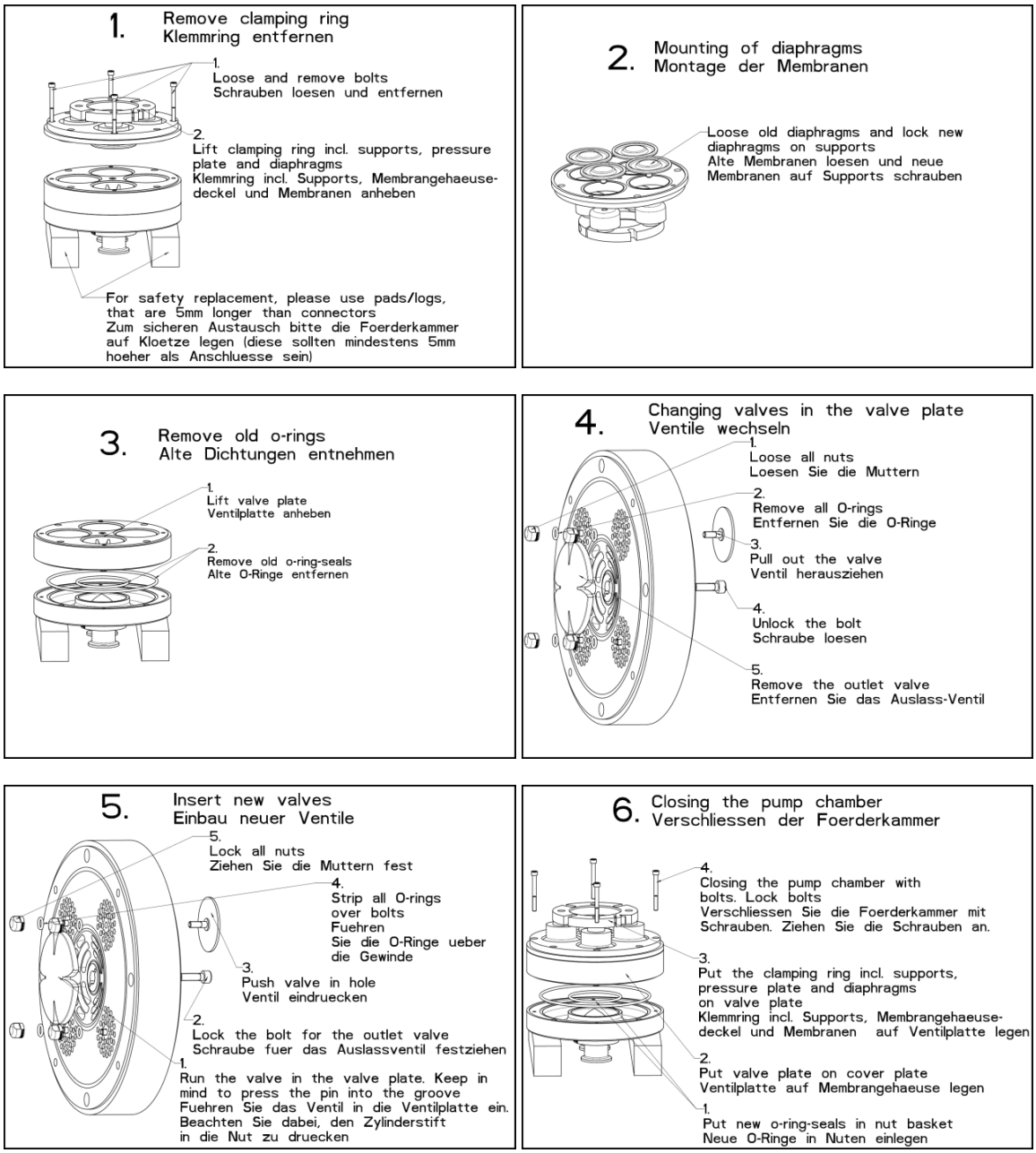
The mounting of the pump chamber can be done by the user as well:


1.
Straighten the pump chamber to the ring drive and press the pump chamber into the ring drive!
ATTENTION! VERY HEAVY! Appr. 19 kg!
Foerderkammer in Ringantrieb einfuehren und fixieren! ACHTUNG! SEHR SCHWER! Ca. 19 kg!


2.
Lock clamping ring
Klemmring festschrauben
3.
Lock hexagon socket screw plug
Verschlussschraube einsetzen und verschrauben
2.
Lock bolt of clamping ring inside the housing with an Allen key, wrench size 6mm
Festziehen der Klemmschaube im Pumpengehaeuse mit Innensechskantschluessel 6mm
1.
Lock bolts of pump chamber
Schrauben der Foerderkammer festschrauben

4.3 Changing seals and diaphragms:

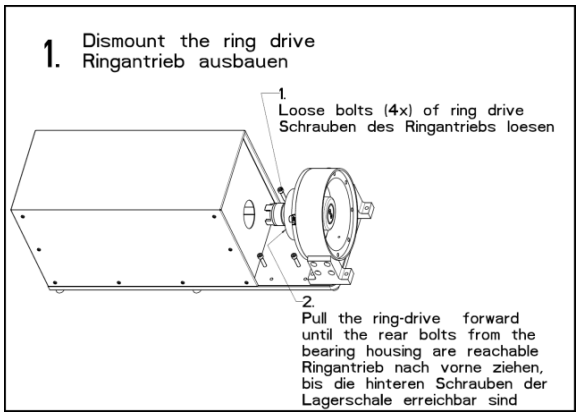
The changing of the diaphragm and the valves can be done by the user.
Please follow the schematic drawings “4.1 Dismount he pump chamber”
Spare part kit: PSKITQF4400

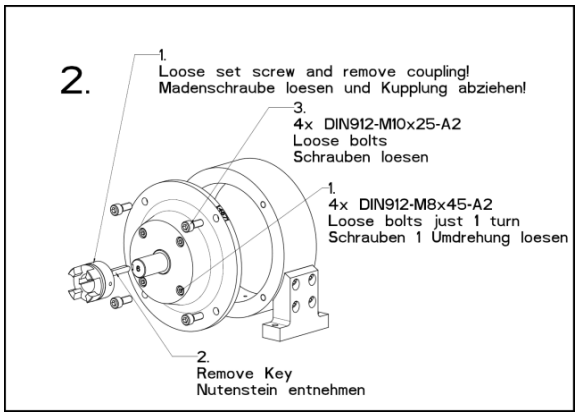

1. Remove clamping ring
Klemmring entfernen
1. Loose and remove bolts
Schrauben loesen und entfernen
2. Lift clamping ring incl. supports, pressure plate and diaphragms
Klemmring incl. Supports, Membrangehaeuse-deckel und Membranen anheben
For safety replacement, please use pads/logs, that are 5mm longer than connectors
Zum sicheren Austausch bitte die Foerderkammer auf Kloetze legen (diese sollten mindestens 5mm hoeher als Anschluesse sein)
2. Mounting of diaphragms
Montage der Membranen
Loose old diaphragms and lock new diaphragms on supports
Alte Membranen loesen und neue Membranen auf Supports schrauben
3. Remove old o-rings
Alte Dichtungen entnehmen
1. Lift valve plate
Ventilplatte anheben
2. Remove old o-ring-seals
Alte O-Ringe entfernen
4. Changing valves in the valve plate
Ventile wechseln
1. Loose all nuts
Loesen Sie die Muttern
2. Remove all O-rings
Entfernen Sie die O-Ringe
3. Pull out the valve
Ventil herausziehen
4. Unlock the bolt
Schraube loesen
5. Remove the outlet valve
Entfernen Sie das Auslass-Ventil
5. Insert new valves
Einbau neuer Ventile
5. Lock all nuts
Ziehen Sie die Muttern fest
4. Strip all O-rings over bolts
Fuehren Sie die O-Ringe ueber die Gewinde
3. Push valve in hole
Ventil eindruecken
2. Lock the bolt for the outlet valve
Schraube fuer das Auslassventil festziehen
1. Run the valve in the valve plate. Keep in mind to press the pin into the groove
Fuehren Sie das Ventil in die Ventilplatte ein. Beachten Sie dabei, den Zylinderstift in die Nut zu druecken
6. Closing the pump chamber
Verschliessen der Foerderkammer
4. Closing the pump chamber with bolts. Lock bolts
Verschliessen Sie die Foerderkammer mit Schrauben. Ziehen Sie die Schrauben an.
3. Put the clamping ring incl. supports, pressure plate and diaphragms on valve plate
Klemmring incl. Supports, Membrangehaeuse-deckel und Membranen auf Ventilplatte legen
2. Put valve plate on cover plate
Ventilplatte auf Membrangehaeuse legen
1. Put new o-ring-seals in nut basket
Neue O-Ringe in Nuten einlegen

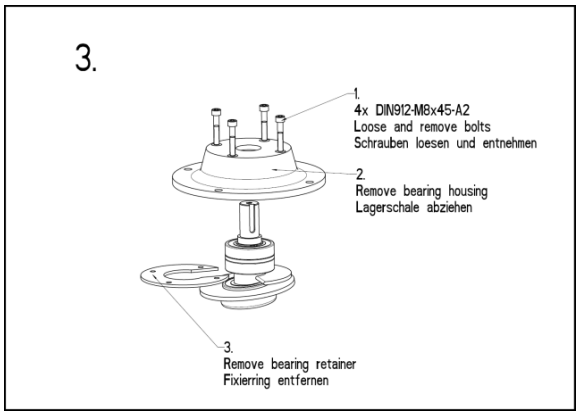
Please follow the schematic drawings of “4.2 Mount the pump chamber”

4.4 Changing of the shaft bearing unit

The changing of the shaft-bearing unit can be done by the user.
Please follow the schematic drawings “4.1 Dismount the pump chamber”


1. Dismount the ring drive
Ringantrieb ausbauen
1.
Loose bolts (4x) of ring drive
Schrauben des Ringantriebs loesen
2.
Pull the ring-drive forward until the rear bolts from the bearing housing are reachable
Ringantrieb nach vorne ziehen, bis die hinteren Schrauben der Lagerschale erreichbar sind





4. Mounting in reverse order with the new shaft bearing unit

5. Please follow the schematic drawings of chapter “4.2 Mount the pump chamber”

5. Operating troubles, causes and remedial action

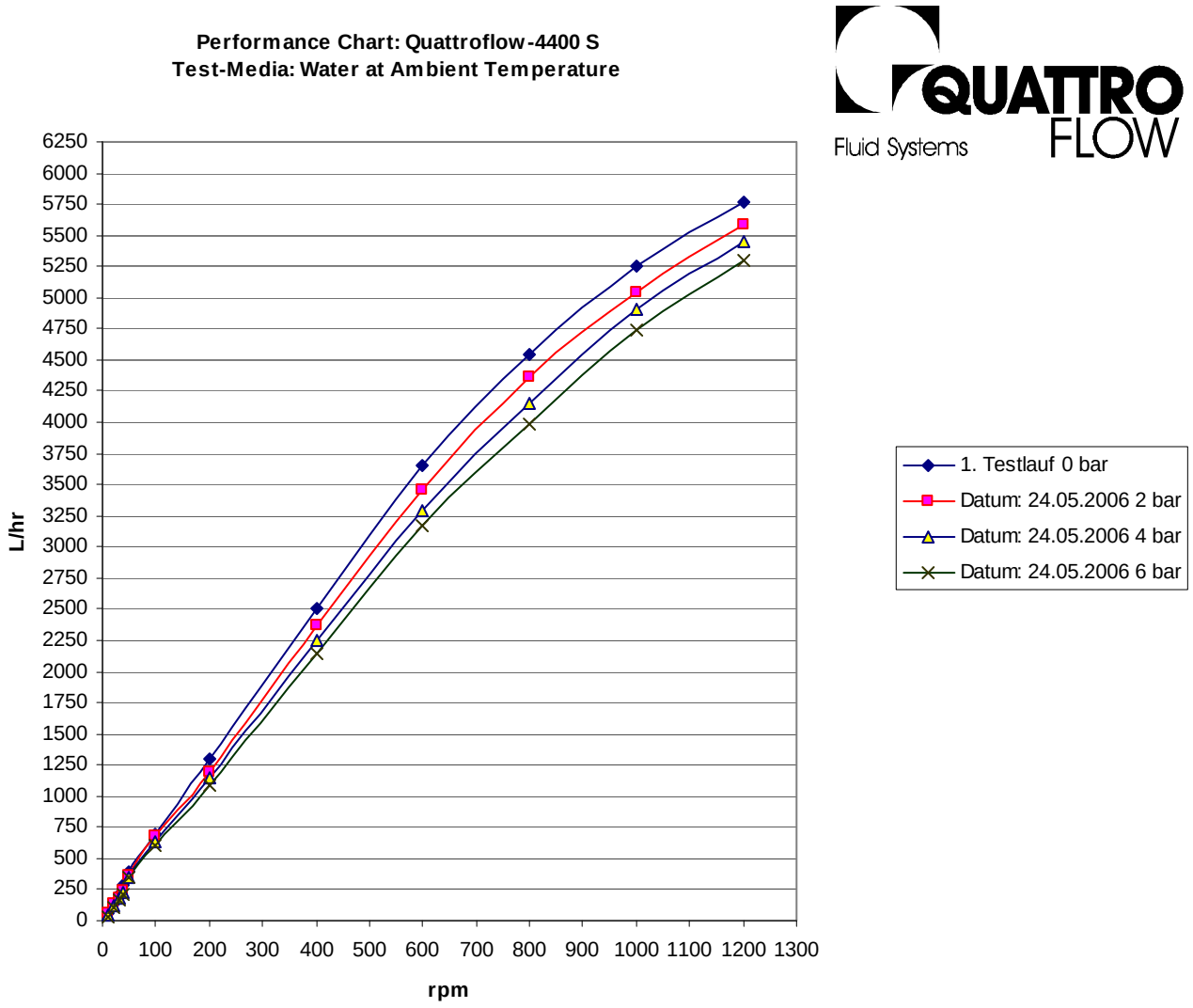
No.	Operating troubles									Causes and remedial action
	Pump does not start	Pump does not prime	Delivery is not obtained or reduced	Pressure head is not obtained	Irregular pump delivery	Pump operates noisily	Pump is leaky	Motor gets too warm	Display show Error code	The 4-piston diaphragm pump operates trouble-free at any time provided they are applied according to the operating conditions mentioned in this manual. If you have any questions, please contact Quattroflow.
	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	
1		X					X			The screws of the pump-chamber maybe not tightened enough. Fix it!
2		X								Check the direction of flow showed by the arrow on the pump, in case of wrong way, turn the pump head
3		X	X			X				Check suction pipeline and TC- seals for tightness
4		X	X	X	X					Check suction head-increase suction line cross section.
5		X	X	X						Check viscosity of liquid pumped.
6	X									Check pump speed. Control speed of drive motor. Check voltage and frequency
7			X	X	X					Avoid air inclusions in the liquid to be pumped
8			X		X					Check pressure head-open valve in discharge line completely, remove obstruction in discharge line
9							X			Pressure line completely or partly clogged Diaphragm maybe broken Change diaphragm!
10			X							The diameter of the pipes in suction or pressure line are to small
11						X				Check the coupling halves. They must be fixed with at least 2-3mm space.
12						X				Check longitudinal play of coupling rod pins. The spider might be worn.
13		X	X		X					Check whether foreign bodies in pump. Disassemble pump, remove foreign bodies, replace defective parts
14	X							X		Pump stopped by the Thermistor switch. Please allow the motor to cool down – please reduce the power consumption.
15	X					X				Bearings are worn or defective. Disassemble pump, replace the shaft – bearing unit
16		X								The valves are dry (i.e. not in use for a long time), deformed or worn. Change valve or wet the pump.
17							X			The diaphragm is burst (the discharge pressure was too high) - replace it with PSKITQ20k
18		X	X	X			X			O – rings between valve plate and pump housing are defective - replace it with PSKITQ4k
19						X				Align coupling accurately
20			X			X				The clamping ring screw got loose – fix it! See 4.2 Mount the pump chamber (picture 2)

6. Performance chart of the Quattroflow QF4400 pump

Performance Diagram Quattroflow QF4400 Pump
Test media: Water at ambient temperature
Discharge pressure: 0 to 6 bar

6.1 Diagram 1: Approximate flow rate as function of pump rpm.

Please note, if motor is directly coupled to pump: Pump rpm = motor rpm
If reducer gear drives are used: Pump rpm = motor rpm x reduction ratio



7. Technical data of the Quattroflow QF4400 pump

4-piston-diaphragm pump:	
Eccentric shaft:	6°
Flow rate max:	Appr. 100-5000 L/h at 0 bar
Pressure	Appr. 0-6 bar
Pressure (temperature of fluid < 40 °C) max:	8 bar
Pressure (temperature of fluid > 40 °C) max:	4 bar
Volume of pump chamber without connectors:	Appr. 820ml
Surfaces area with contact of fluid:	Appr. 1680cm²
Residual volume, depends on position of ports:	80ml
Temperature of fluid:	CIP 90°C, SIP 125 °C, Autoclave 125°C
Speed range:	60 - 1000 rpm
Diaphragm:	EPDM/PP compound (Santoprene)
Valves:	EPDM
O-rings:	EPDM
Available certificates for elastomer parts:	FDA 177.2600, USP Class VI, ADIfree
Outlet Valve plate (standard)	Polypropylene (PP) PVDF
Optional available: stainless steel outlet valve plate	Stainless steel 1.4435/316L, optional 1.4539 e-polished, Ra < 0,4µm, Ferrite < 1%
Pump housing:	Stainless steel 1.4435 optional 1.4539 e-polished, Ra < 0,4µm, Ferrite < 1%
Connector inlet (standard) -other dimensions are available:	TC-clamp 1,5", Stainless steel 1.4435 optional 1.4539, e-polished Ra<0,4µm
Flange diameter inlet:	50,5 mm
Internal diameter inlet:	34,5 mm
Connector outlet (standard) -other dimensions are available:	TC-clamp 1,5", Stainless steel 1.4435 optional 1.4539, e-polished Ra<0,4µm
Flange diameter outlet:	50,5 mm
Internal diameter outlet:	34,5 mm
Available certificates for stainless steel parts:	DIN EN 10204 3.1 B, Ra / Ferrite
Position of connectors:	front
Motor (standard):	VEM, 4-pol, 2,2kW, 400VAC, 3-phases
Cooling fan (standard):	90 W, 230/400VAC, 1/3 phase
Coupling:	KTR
Base plate:	Stainless steel 1.4301, e-polished
Motor housing:	Stainless steel 1.4301, e-polished
Dimensions (L / W / H):	770x250x345
Weight of the pump (equipped with PP-Inlet-Valve-Plate):	Appr. 80-95 kg (depending on equipment)
German custom tarif number:	84138190